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17. — *Lectures on the Elements of Comparative Anatomy.* By THOMAS HENRY HUXLEY, F. R. S. — *On the Classification of Animals, and on the Vertebrate Skull.* London: Churchill. 1864. 8vo. pp. 303.

PROFESSOR HUXLEY gives us with this volume the first instalment of a series which he tells us he hopes to complete some day, and which will eventually form a comprehensive, systematic work on Comparative Anatomy. Although the fragility of literary promises is proverbial, and the experience of the past in such affairs would lead us to fear that, if Mr. Huxley's be fulfilled at all, it will be at a day when most of us shall be slumbering in our graves, yet so great are Mr. Huxley's vigor and activity, and the vivacity of his mind gives the impression that he possesses such good "viability," that we have strong hopes of not being disappointed in his case.

Mr. Huxley is a young man, under forty we believe. Yet he has made valuable contributions to almost every province of anatomical science. His labors in Histology, the morphology of Mollusks and Articulates, and the structure of Acalephs, are among his most important special claims to our respect; but he has left the mark of the strong grasp he takes on many other subjects. If naturalists were divided as politicians are, Mr. Huxley would be said to belong to the left wing. He inclines generally to that view of the phenomena of life which makes them result directly from the general laws of matter, rather than from the subordination of those laws to some principle of individuality, different in each case. He disapproves of the common reasoning from final causes in biology, and says, that when Cuvier thought he was reasoning from them in his reconstruction of the fossil Vertebrata, "he mistook the nature of his own mental processes." He has faith in the doctrine of Transmutation of Species; and the instant Mr. Darwin's book appeared, he published an earnest plea that it might have a fair and respectful hearing. He is perhaps best known in this country by two small books bearing on this very subject, which were reprinted in New York a couple of years ago; — one entitled "Six Lectures to Workingmen on the Origin of Species"; the other, "Three Essays on Man's Place in Nature," etc. In these we see, as in all his writings, his love of coming rapidly to a definite settlement of every question, deciding either Yes or No, if that be possible; or if not, pointing out exactly what kind of data we must have before we can draw a fair conclusion. He concludes the former of the two little works above mentioned, which is an admirably written account of the present state of the great problem, by accepting Mr. Darwin's hypothesis, *provided* it

shall be found compatible with the fact of sterility between animals of different species. As things now stand, we cannot tell whether it is compatible or not.

In the second work, he gives us an example of radicalism truly refreshing in an Anglo-Saxon. As to "the doctrine of creation by jerks," he renounces it altogether, and jovially says that, if we admit the transmutation hypothesis at all, we must apply it even unto majestic man, and see in him the offspring of some great ape, pregnant with Futurity. Probably our feeling on this point, more than anything else, will make many of us refuse to accept any theory of transmutation. This is indeed not the place to discuss the question, but we think it could be easily proved that such a feeling has even less foundation than any other aristocratic prejudice. It behooves us at any rate to examine a little into its grounds, when we see it in such serious danger of shortly being trampled under foot as we do at the present time. A doctrine like that of transmutation of species, which as fast as it is buried in one form reappears in another, and shows itself each time more robust and vivacious than before, cannot but be treated with some respect; and when we find that such naturalists as Asa Gray, Lyell, Owen, Schleiden, Vogt, Von Baer, Kölliker, many of whom but a few days ago were publicly opposing it, are now coming round, one by one, to espouse it, we may well doubt whether it may not be destined eventually to prevail. Perhaps, by accustoming our imagination to contemplate the possibility of our ape descent now and then, as a precautionary measure, the dire prospect, should it ever really burst upon us, will appear shorn of some of its novel horrors, and our humanity appear no less worthy than it was before.

The result of Professor Huxley's discussion of the composition and development of the skull, in this volume, is such as to make him give a conclusion strongly adverse to that theory which regards it as a series of modified vertebræ. The whole history of this celebrated theory is very interesting to one who likes to watch the play of the two great intellectual tendencies which, since men began to speculate, have shared the world between them, and filled it with the sound of their contention, and which we may call the synthetic tendency and the analytic tendency. Of course such a division is not absolute, for every mind must be at the same time both analytic and synthetic; nevertheless, as in every question we generally find two sides, and the advocates of one may be called synthetic as compared with their opponents, the distinction, so long as we bear in mind that it is only relative, is both convenient and natural.

Our sensible perceptions present to us nothing but an endless confu-

sion of separate things; our reason whispers that all these things are connected, and that what appears superficially confusion is at bottom perfect order and harmony. The analytic men seem to hear the voice of the senses best, the synthetic men that of the reason. "L'univers," says D'Alembert, "pour qui saurait l'embrasser d'un seul point de vue, ne serait, s'il est permis de le dire, qu'un fait unique et une grande verité." It is with the hope of one day reaching this sublime point of view that Science struggles ever forwards, spurred passionately on over the slow and difficult approaches by her synthetic followers, while her analytic ones moderate her speed and keep her from wandering away from the right path. To get her to the goal, the services of both are indispensable, for either class is infirm alone, and needs the other to make up for its shortcomings. The synthetists are theorists, who require their knowledge to be organized into some sort of a unity. They see resemblances better than differences. The analysts are actualists, who are quite contented to know things as isolated and individual, who see differences better than resemblances. On the one hand, the men of intuition, whose eye leaps over the steps at once to the goal; on the other, the men of demonstration, whose eyes are fixed so steadfastly upon the steps that they often do not see the goal at all.

The important part intuition or imagination plays in Science has of late been so fully recognized and so ably vindicated, that no more need be said about it. But the imaginative temperament, if left unchecked to deal with science, would run into endless excesses. Men of this cast of mind are impatient. Their desire of unity is so fervid, that they leap eagerly to embrace any apparent simplification of things, however absurd it may be at bottom. They are so fond of short cuts as often to drive through perfect stone-walls of fact, as if they were blind, but without the caution of the blind. For the scope of any individual mind is very narrow; we can see vividly but a very few things, and practically ignore the existence of the rest. If we are of a synthetic mould, we build these few up into a more or less comfortable system; and then, without reflecting that what to our consciousness shuts out all individual eccentricity may yet, when tested by a wider synthesis, prove to be one egregious eccentricity from beginning to end. We are too apt to resent the criticisms of practical men on our plans as assaults upon the very spirit of truth itself. We forget what the proverb says, "The longest way round is the shortest way home."

The vertebrate theory of the skull was the creation of synthetic minds. In its first form it was strongly opposed by Cuvier, who may be taken as the representative of analytic minds. It was then revived by Owen as part of a scheme which in the mind of its author was cer-

tainly synthetic, namely, that of a common plan of vertebrate structure existing in the Creative Mind, and underlying all the special contrivances by which the various creatures are fitted for their different modes of life. This scheme would be now considered by many as tending to multiply original principles in nature, and consequently as not synthetic enough. We are pretty sure that Mr. Huxley would be one of these objectors to it, and so far forth would be more synthetic than Professor Owen; but in the present work he criticises it entirely on analytic grounds.

It was in the first years of this century, in the midst of a very general intellectual ferment, that the notion that the skull was of the same nature as the back-bone arose simultaneously in the minds of several inquirers, working independently of each other. Schelling had said, "To philosophize upon nature is to create nature"; and it was armed with this superb maxim that Oken and his disciples proceeded to develop the idea which Oken himself and Goethe had originated. Their results were extravagant and untenable. The head was supposed by them to repeat the rest of the body. We find in Oken, for example, the hyoid bone described as the sacrum of the head, while the lower jaw is the leg, and the tympanic bone the shoulder-blade thereof; and wild as such opinions now appear, they carried everything before them for a time in Germany. In France, the thought seems to have struck M. Duméril about the same time; but it is related that, after he had broached it in the Academy, some member made a mild jest about his "thinking vertebra," which so abashed him that he let the matter drop. Étienne Geoffroy St. Hilaire worked out his version of the theory a few years later. His views were far more sober than those of the Germans; but, according to Cuvier, he had reached them without paying sufficient respect to the facts. It was too rash a synthesis, and this great man combated it to the last day of his life.

Few will deny that Cuvier succeeded in demolishing the particular edifices which Geoffroy and the Germans had reared; but he did not wholly scatter the ruins and plant on the foundation, so the theory was not permanently buried. One can imagine the mixed feeling of wonder and impatience with which this man regarded the airy flights of his mystical opponents, as he calls them, — he who never let his fancy overstep the stones which observation and reasoning kept laying down, surely and slowly, one by one, before it. To quote Mr. Huxley, "The fresher one's study of the wilder Okenians, the more one has become weary of wading through empty speculations upon 'connation' and 'coalescence,' 'irrelative repetition' and 'transposition,' the *Dei ex machina* who are called in to solve every difficulty," (this is one of Mr. Huxley's side-kicks at Professor Owen,) — "the more heartily does one

sympathize with the sarcastic vigor with which Cuvier annihilates the products of their exuberant fancy. Nor is it possible to peruse without admiration the sagacious reasoning by which he was led to determinations which, in the majority of cases, have been accepted by those who have followed him."

Now, in the face of all this, and while admitting that Cuvier has done more than any one man for natural history, it would seem not only paradoxical, but suicidal, to deny that his was a mind of the very highest type. Nevertheless, we cannot help thinking that, if his imagination had been bolder, his stupendous analytical powers would have carried him farther than they did. As it is, his word has less authority when he says "No" than when he says "Yes." He surrounded Science with barriers which we are sure she must one day transcend. He thought that with observation, description, and classification her work was done. Looking through history, and seeing that the best of systems triumphed but for a day, he concluded that systems and syntheses were radically vicious, and deduced "this fundamental axiom of the positive sciences, that facts well observed are for them the only durable acquisition." He considered that every animal forms a complete whole (*un tout unique et clos*), intended to play a definite part in nature, for which part a certain harmony in its organization becomes necessary. Animals, therefore, *essentially differ* from each other, and the resemblances they may show are accidental, and accrue from the similarity of purpose for which they are created. Any other "law" or necessity than that coexistence of organs entailed by these "conditions of existence," Cuvier resented as infringing the Creator's freedom, as implying, in his own words, "*le défaut de liberté dans l'action du principe organisateur.*" According to him, a classification is "a sort of dictionary," the "surest way of expressing the properties of beings in the fewest terms, and of stamping them easily upon the memory." And yet he considers that a perfectly natural classification would be "*toute la science.*" Now, we are sure that Biological Science, eternally grateful as she must be to Cuvier, will not consent to stop at these limits. Her function is not merely to note Resemblance, but to find Unity. Below the *fact* of resemblance she will seek till she lays bare the *ground* of resemblance; she will regard classification as her starting-point rather than her goal; and, far from spurning all "system," she will proclaim that the creation of a perfect system is the very end of her existence. If Cuvier had lived two centuries earlier, he would have been satisfied with knowing the coincidences that Kepler had discovered in the planetary orbits, and would have said, as Leibnitz actually did say, that Newton was impious to try to find their cause.

We had hoped to give some account of Mr. Owen's ingenious and beautiful, though unsatisfactory, theory of the skull. But we find we have no room. Suffice it to say, that of the few who dared to occupy the ruins which Cuvier had left smoking, and tried to build thereon, he met with most success; and many naturalists who looked with suspicion on his edifice found it on the whole so fair that they left it undisturbed. Now comes Professor Huxley, strong with the battering-ram of Embryology, and lays it low. His arguments seem final against the view that the segments of the skull are literal vertebræ. But does such a decision throw us back upon Chaos again? We think not. We think that the undeniable analogy of these segments to true vertebræ will some day be shown to be a true affinity. Both backbone and skull will be affiliated upon some uniform mode of force (working in either under slightly different conditions), in accordance with the principles of a synthesis which is now slowly shaping itself in biology. This synthesis asserts that organic forms, like the forms of the waves of the sea, are the *result* of the common properties of matter. It is but one feature of a still wider synthesis, towards which few will deny that a current seems setting from every quarter of Science, and which may be briefly described as declaring the Self-Competency of Nature.

Now it is certain that this synthesis is, hypothetically at least, atheistic in its tendency, and, as such, its progress causes much alarm to many excellent people. But is this alarm well grounded? Grant that the theory leaves much of our moral experience unaccounted for, and is but a partial synthesis,—grant that at present it turns its back upon the Supernatural,—may it not, nevertheless, serve an excellent purpose, and in the end, by introducing order into the Natural, prove to be a necessary step in the way to a larger, purer view of the Supernatural? Perhaps it may never be established; but if it is, it will do away at any rate with that eternal muddling together of Natural and Supernatural which has prevailed hitherto. God will no longer be made to appear as on a level with Nature and acting as a mere rival to her forces. It will no longer be possible to say, with Professor Owen, that the "general polarizing or vegetative vital force" is "*in antagonism with* the special adaptive force by which the Sovereign of the Universe attains his ends, and promotes the interests of the animal"; nor, with Dr. Whewell, that, although the idea of a final cause is applicable as a fundamental idea to our speculations concerning organized creatures *only*, yet "we find abundant reason to believe that there *is* a purpose in *many other* parts of Creation." But is it likely that then, any better than now, we shall be able utterly to stifle our idea of final cause, or go off satisfied with an answer to *How?* when the question we asked was *Why?* May it not be that, find-

ing Nature a great closed sack, as it were, *tota, teres, atque rotunda*, without any *partial* inlets to the Supernatural, without any *occasional* Ends *within* her bosom, we shall be driven to look for final causes on some deeper plane underlying the whole of Nature at once, and there shall find them? Both sides will then be satisfied, and the exclusively naturalistic tendency of modern thought will have its justification. However, let us not meddle with prophecy, — it is dangerous; but let us return to the solid earth, and examine a little into the details of Mr. Huxley's volume.

Perhaps the most original feature of his discussion of the separate cranial bones lies in his application of the long neglected discovery of Kerckring, that the human petro-mastoid part is primitively composed of three distinct bones, to the identification of the bones of the side of the head in the lower Vertebrata. These three "peri-otic" bones he calls respectively "pro-," "epi-" and "opisth-" otic, and he finds them largely developed everywhere, most frequently either separate or with the marks of an original separation between them. It is in his pursuit of these bones that he makes those determinations that differ most from those of his predecessors. Thus, in bony fishes he makes the exoccipital and alisphenoid of Cuvier and Owen, as well as their petrosal, belong to the ear capsule, while their mastoid is his squamosal, he recognizing of course no separate mastoid. The quadrate and quadratejugal of birds and reptiles retain these names. Mr. Huxley considers them to have no representatives in the mammalian cranium. Cuvier identified the quadrate with the tympanic in man, and his interpretation has been generally followed. "But," says Huxley, "the tympanic is always a membrane bone, whereas this [the quadrate] is always a cartilage bone. The tympanic directly supports the tympanic membrane, while this bone sometimes gives no direct attachment to the tympanic membrane at all. The tympanic of Mammals again becomes smallest in those Mammalia which most nearly approach birds and reptiles, and is never known to articulate, by a movable joint, with the *malleus*, which, as we have seen, is the representative of the *os articulare* of the mandible of the lower Vertebrata. It is impossible, therefore, that the quadrate bone should be the homologue of the tympanic of Mammalia. On the other hand, it corresponds altogether with the quadrate bone of Fishes, which is united in like manner with the pterygoid arcade, and is similarly connected by a movable joint with the articular piece of the mandible; and this quadrate bone of Fishes is, I have endeavored to show, the homologue of the *incus* of the Mammalia. I make no question that, as Reichert long ago asserted, the Bird's *os quadratum*, and therefore that of the Reptile, is the equivalent of the mammalian *incus*." (p. 229.) We think all this is

still somewhat problematical. Mr. Huxley, although inclined to consider that histological development is as good a test of homology as morphological development, admits himself that we cannot yet be positive on this point. M. Hollard, in the *Ann. des Sciences Naturelles* for the past year, has been led by the study of development in the salmon to homologize the interoperculum with the incus, and the hyo-mandibular, symplectic, and preoperculum, taken together, with the styloid process. If this were so, the quadrate and metapterygoid (Cuvier's *tympanal*) would seem to answer to nothing better than to the tympanic. However, more work needs to be done before this question can be settled.

We are sorry that the lack of space will prevent our giving anything like an analysis of the Lectures on Classification. We will merely subjoin a list of Mr. Huxley's primary divisions and classes of animals.

PROTOZOA: *Gregarinida, Infusoria, Rhizopoda (?), Spongida.*

CŒLENTERATA: *Hydrozoa, Actinozoa.*

MOLLUSCOIDA: *Polyzoa, Brachiopoda, Ascidioda.*

MOLLUSCA: *Lamellibranchiata, Branchiogasteropoda, Pulmogasteropoda, Pteropoda, Cephalopoda.*

ANNULOIDA: *Scolecida (?), Echinodermata.*

ANNULOSA: *Annelida, Crustacea, Arachnida, Myriapoda, Insecta.*

VERTEBRATA: *Pisces, Amphibia, Reptilia, Aves, Mammalia.*

Mr. Huxley admits that much of this is provisional. His review of the classes is admirable for clearness and condensation. The diagrams of dissections which illustrate his descriptions add greatly to the value of the book, and we shall doubtless find most of them gracing the pages of elementary treatises for twenty years to come. The woodcuts with which the Lectures on the Skull are furnished are also as good as they are abundant.

In taking leave of a book in most respects so admirable, it is unpleasant to find fault; but we must say a word in condemnation of the uniformly rude, and even malignant, tone in which Mr. Huxley speaks of Professor Owen. It is a way he has with all opponents,* but espe-

* Some readers may remember a little "spat" which Mr. Huxley had within the past year with Dr. Hunt and Mr. Blake of the Anthropological Society, concerning the pamphlet of the former on "The Negro's Place in Nature." However contemptible Dr. Hunt's *animus* may have been, Huxley's tone was unjustifiable. *Apropos* of the Anthropological Society, we cannot resist citing an episode of the debate which took place therein about the negro, on the occasion of the same pamphlet. Straws show how the wind blows. MR. BURKE is saying that our superiority to the negro is parallel to our superiority to the white peasant.

MR. MCHENRY. No; it is not.

MR. BURKE. I differ from you in opinion very widely.

MR. MCHENRY. And I do from you. I am afraid you are an abolitionist, sir.

MR. BURKE. This gentleman is at liberty to have his own opinions, and of

cially with Owen, who is savagely sneered at by name and by allusion on every possible occasion. It is a state of things discreditable to Science, when, to use the words of an English critic, people go to Professor Huxley's lecture-room with somewhat of the same spirit as that with which they would flock to a prize-fight.

We very much wish that this volume might be republished in this country, and that our students of medicine, at least, might get a smattering, however small, of scientific anatomy. But we fear the day has not yet arrived. Meanwhile, those who would like to see the book, and who cannot afford to buy it, will find the Lectures reported in the Medical Times and Gazette for the first months of 1864.

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18. — *Icones Muscorum, or Figures and Descriptions of most of those Mosses peculiar to Eastern North America which have not been heretofore figured.* By WILLIAM S. SULLIVANT, LL. D. With one hundred and twenty-nine Copperplates. Cambridge: Sever and Francis. London: Trübner & Co. 1864.

ORDINARILY a special and technical work like this, upon a particular and somewhat neglected branch of botany, would not call for notice here. This does so because of its rare perfection as a work of art as well as of science. The volume is an imperial octavo, in typography worthy of the University Press. The plates are devoted for the most part each to the illustration of a single species, — the Moss being delineated first of the natural size, whether large, like the Peat-mosses, with which the series begins, or minute, like the ephemeral *Phasca* which follow, — then in magnified views and analyses of part after part, until the whole structure is clearly revealed. Numerous and, from their greatly enlarged size, predominating as are the detailed figures, yet they are so skilfully managed as to avoid the appearance of crowding or confusion. Each plate tells its story gracefully as well as accurately. We may well suppose that Bruch and Schimper's *Bryologia Europæa* has served as a model; but these plates are more exquisite, mainly because upon copper instead of stone, and on the whole are probably unequalled. The author assigns the whole credit to his draughtsman, Mr. August Schrader, whom he has sedulously trained to the work, and

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course he will let me have mine. I contend that the difference is one of degree only.

MR. MCHENRY. I pity you; you do not know better. &c., &c., &c.

Does not this sound like our own blessed land in the good old times? MR. MCHENRY expressed the sense of the majority of the meeting.